Workshop on Age Reading of Chub Mackerel (*Scomber colias*) [WKARCM]
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Annual growth pattern and age validation trials of *Scomber colias* in the Bay of Biscay using otoliths

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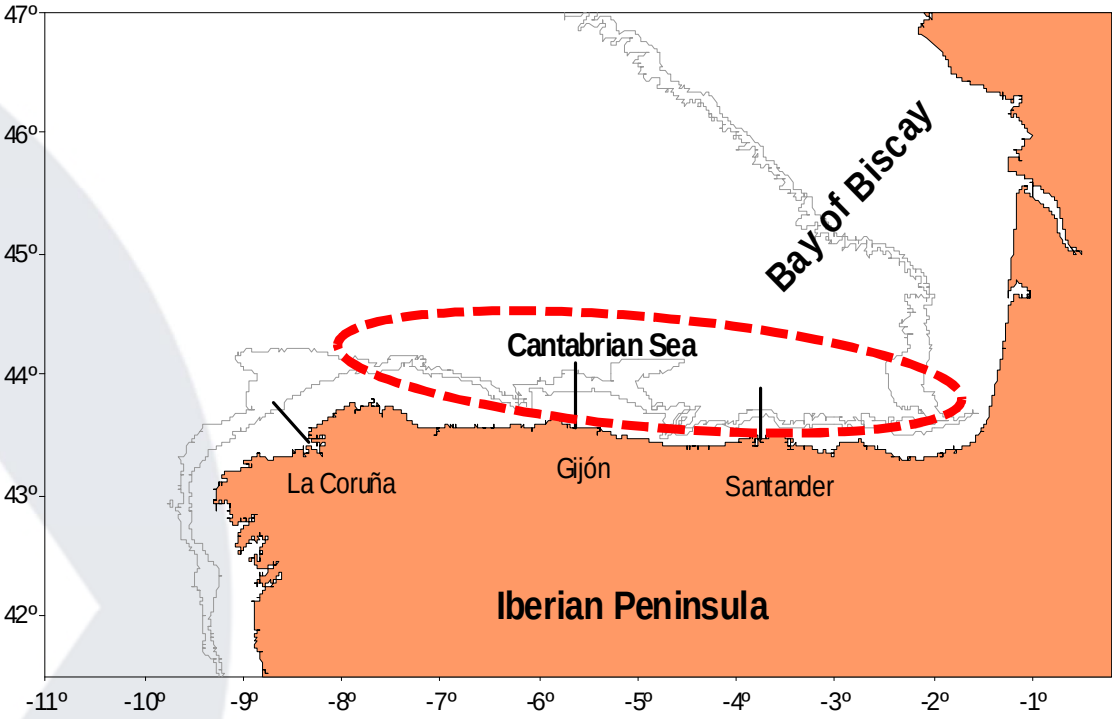
Background

- ✓ The age estimation criteria of *S. colias* are not still internationally standardized and have never been validated or corroborated in Iberian waters.
- ✓ This work presents the growth pattern in the Bay of Biscay (Cantabrian Sea, ICES Div. VIIIc) based on samples from a period of two years (2011, 2012).
- ✓ A semi-direct validation of the age estimation of this species in the area is performed, at first time, based on the nature of the edge and the otolith marginal increment analyses.
- ✓ A verification criterion is also performed, the consistency of the age interpretation is tested by the regularity of the increments formation.

Material and Methods

- ✓ A total of **1991** *S. colias* collected from landings of commercial vessels during 2011 and 2012 (Cantabrian Sea, ICES Div. VIIIc) were sampled.
- ✓ In addition, **590** individuals were sampled during the acoustic surveys PELACUS0411 and PELACUS0412, and **29** individuals from the trawl surveys DEMERSALES2011 and DEMERSALES2012, carried out in April and September of 2011 and 2012, respectively.
- ✓ Total length of all samples was measured to the nearest mm.
- ✓ A total of **2185** pair of sagitta otoliths were aged, 1447 of which from the first semester and 738 from the second.
- ✓ The nature of the edge (hyaline or opaque) was also recorded for all of them.



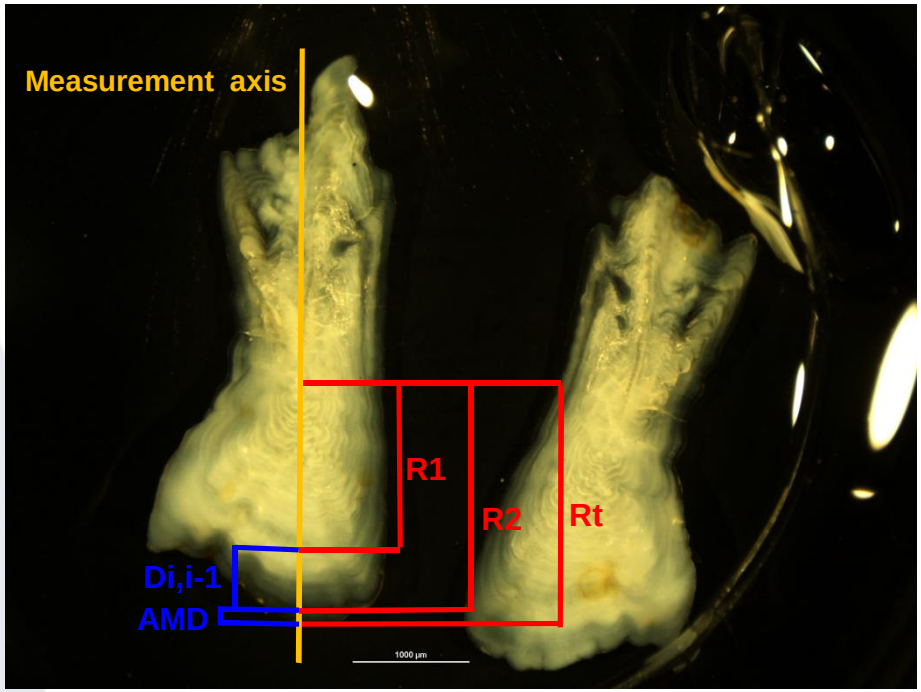
YEAR	Commerial landings			Surveys			TOTAL
	Sem 1	Sem 2	Total	Sem 1	Sem 2	Total	
2011	461	322	783	245	9	254	1037
2012	561	387	948	180	20	200	1148
TOTAL	1022	709	1731	425	29	454	2185

Material and Methods

- ✓ Diameter and radius of **343** otoliths were measured, as well as the radius of each annulus. This otoliths were selected in order to obtain a good representation of otoliths by month, sex and fish length.

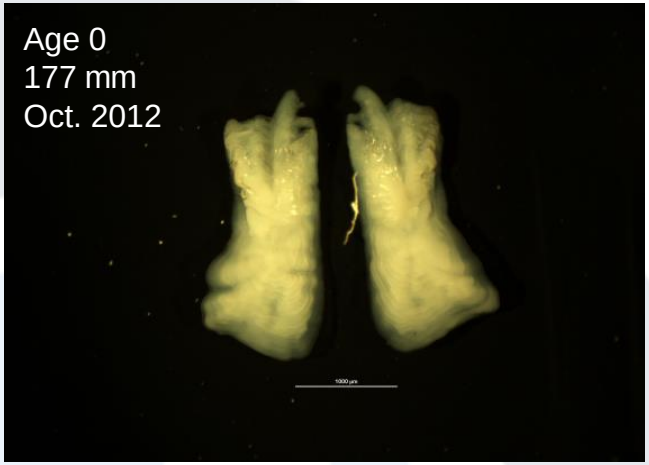
- ✓ The absolute marginal distance (**AMD** = distance between the end of the last hyaline annulus and the edge) and the distance between the last two hyaline annuli (Di,i-1) were also measured in **111** of those otoliths, for estimating the relative marginal distance (**RMD** = ratio of the AMD and Di,i-1) (Panfili 2001).

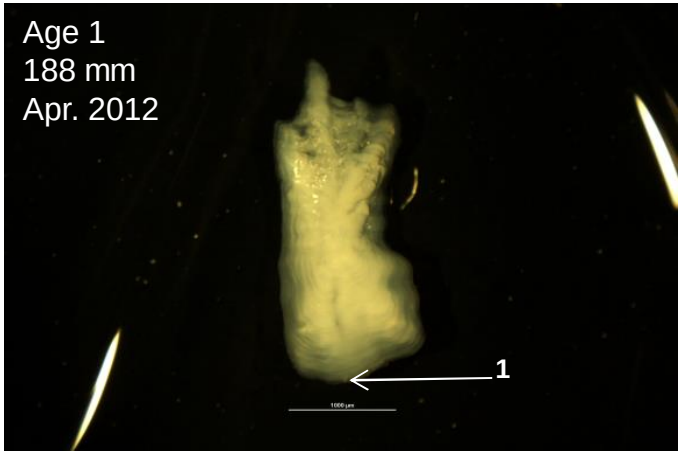
- ✓ All these measurements obtained using a microscope connected to an image analyzer (NIS-Element) and recorded in microns (µm).

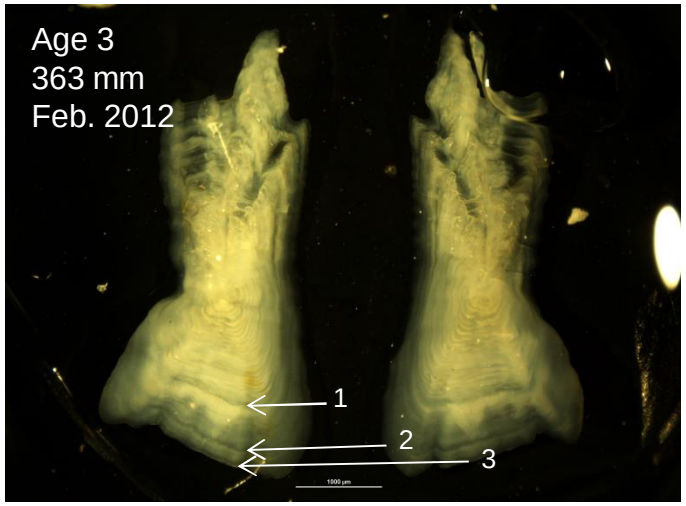


	Otoliths measured				Otoliths with RMD			
	Males	Females	Indeterm.	TOTAL	Males	Females	Indeterm.	TOTAL
2011	47	62	9	118	11	13	0	24
2012	115	98	12	225	51	36	0	87
TOTAL	162	160	21	343	62	49	0	111

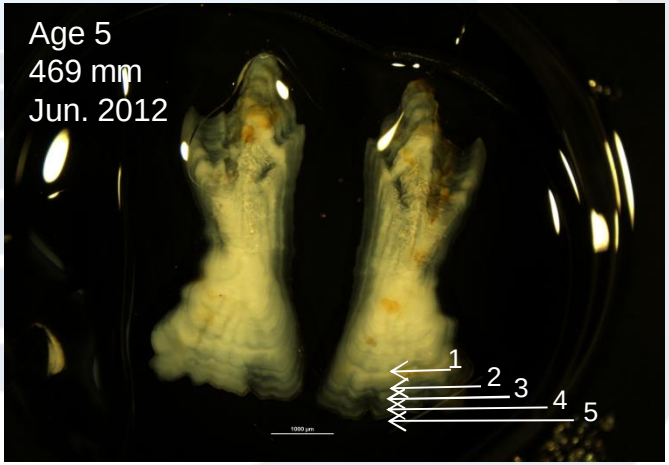
Typical Chub mackerel otoliths in Division VIIIc



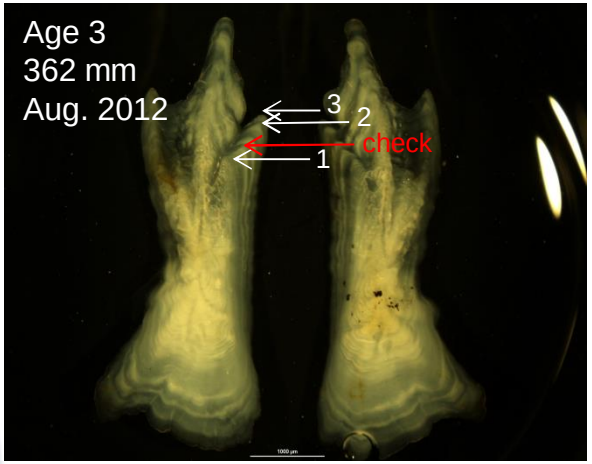


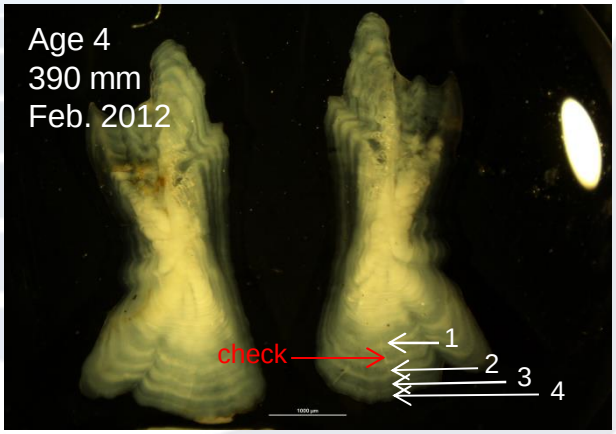


Typical Chub mackerel otoliths in Division VIIIc



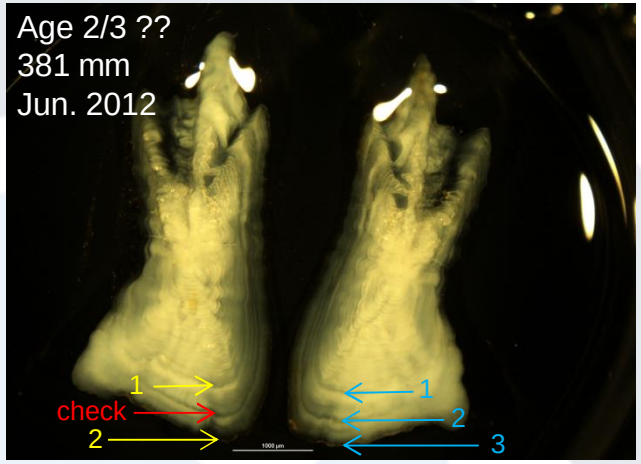
Difficulties: Checks (false rings)

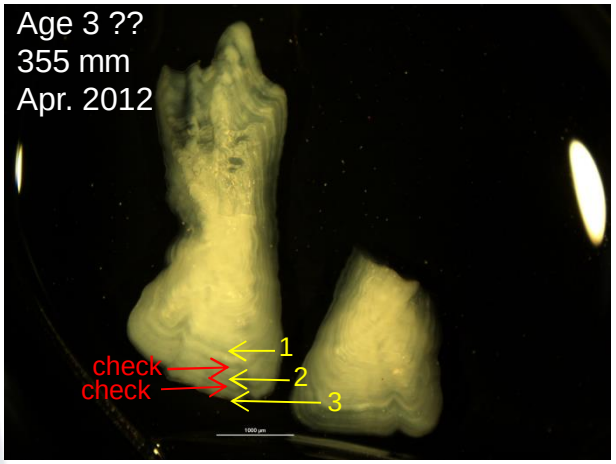




✓ Checks well identified. Otoliths **included** in the study.

Difficulties: Checks



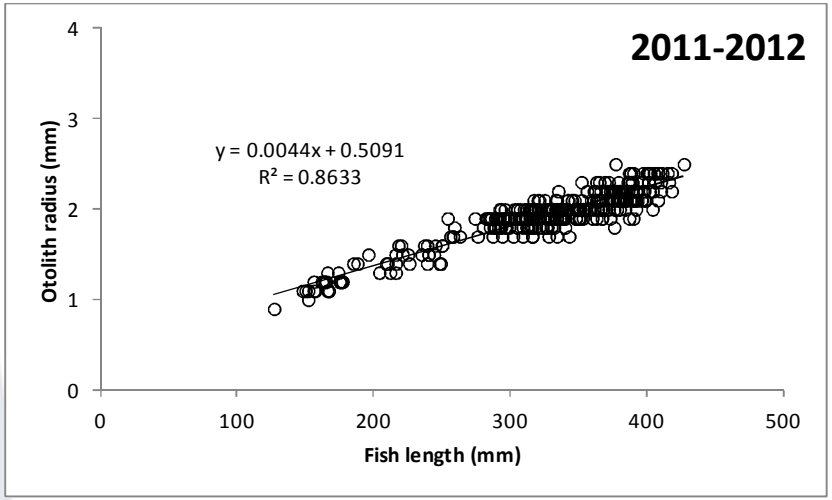


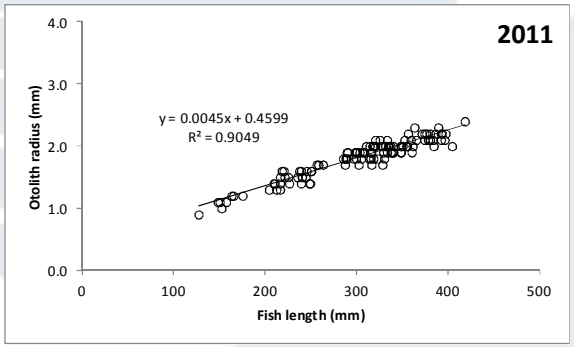
✓ Doubts when assigning the age in this kind of otoliths: **NOT used in this study**

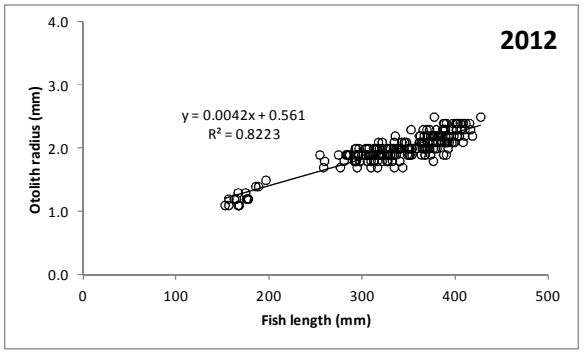
Results

Otolith radius/Fish length relationship

- ✓ The relationship between otolith radius and fish length was significant, and was expressed as a strong linear relationship.





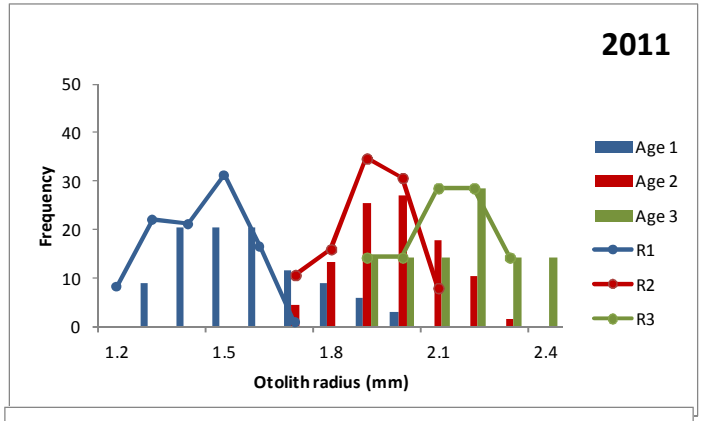


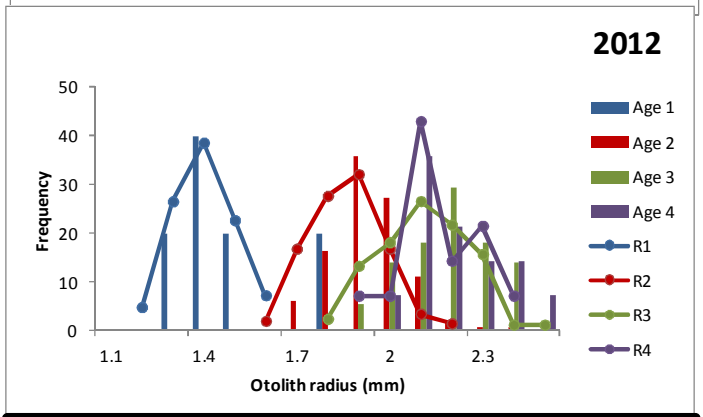
Results

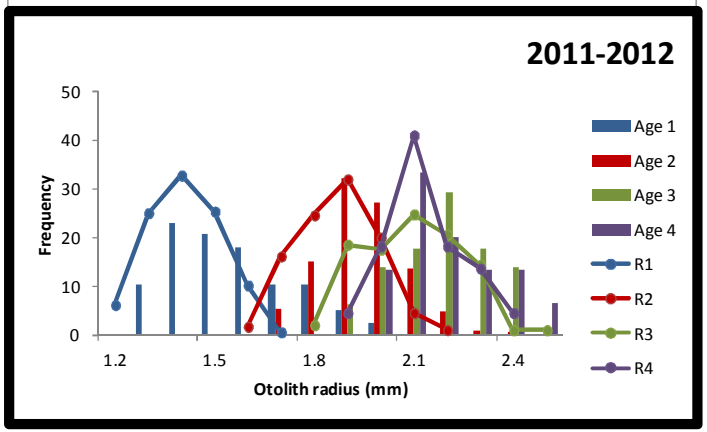
TRENDS IN PATTERS OF GROWTH

- ✓ The distribution of each annulus of *S. colias* have a normal distribution with a decreasing otolith growth rate with age.
- ✓ This linearly decreasing interval between increments is a verification criterion that forms the basis of age estimation (May, 1965).

	Age 1	Age 2	Age 3	Age 4
2011	34	67	7	1
2012	5	117	72	14
2011-2012	39	184	79	15







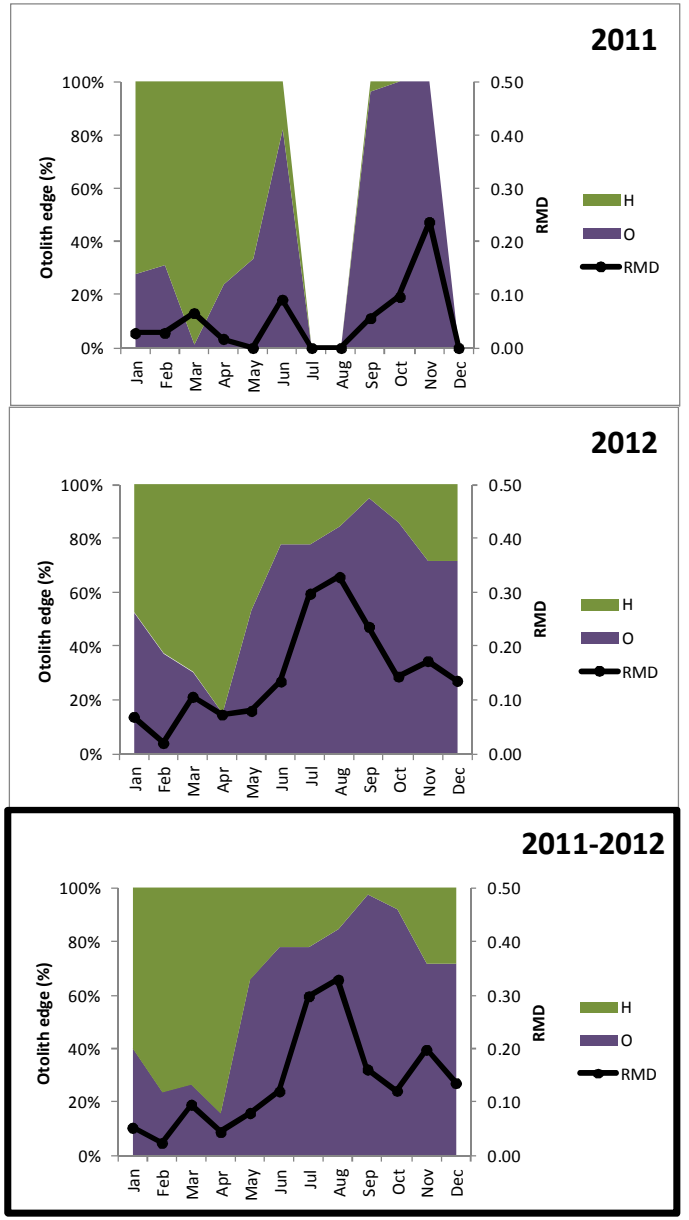
Results

Nature of the otolith edge and marginal increment analyses (RMD)

- ✓ The monthly proportion of edge type of *S. colias* indicates an annual periodicity in the formation of the hyaline and opaque annuli, appearing the opaque edge mainly from June to December
- ✓ The winter (hyaline) annulus seems to be entirely formed in April.
- ✓ RMD also is higher in the second half of the year, between July and December, with higher values in July-August 2012 and November 2011. The variability of this results can be explained by the low number of otoliths from which RMD could be measured.

RMD

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	11	12	10	36		8			10	22	10		119
2012	17	12	29	35	19	17	10	14	14	25	15	19	226
2011-2012	28	24	39	71	19	25	10	14	24	47	25	19	345



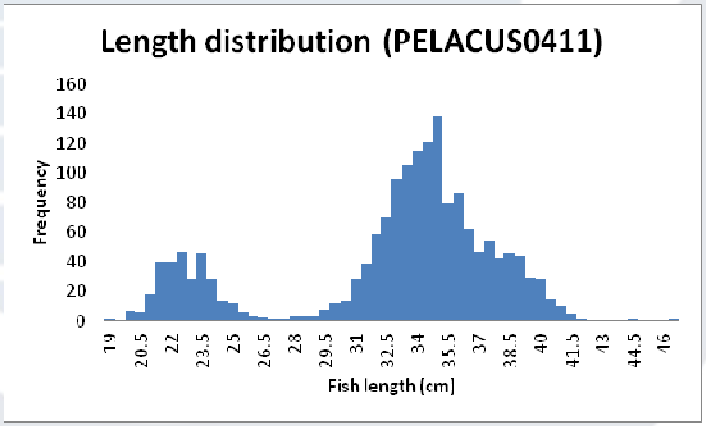
Results

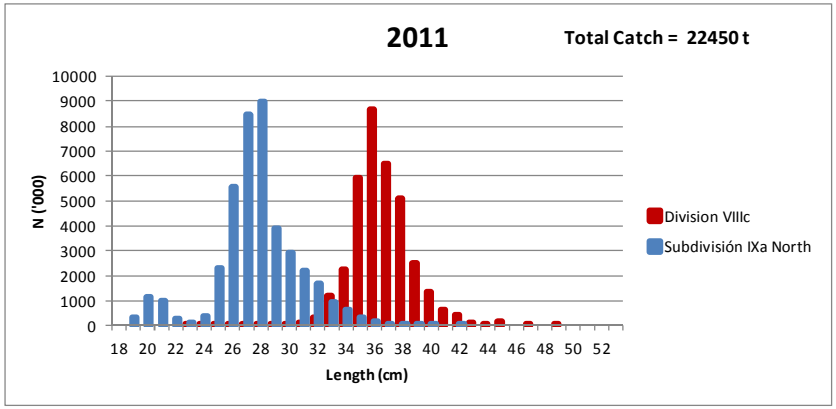
Catch Length distribution

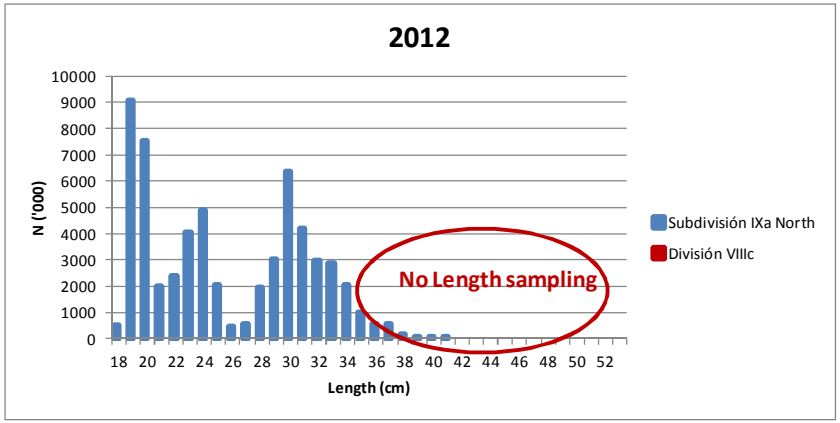
✓ The commercial catches of chub mackerel in the Bay of Biscay (ICES div. VIIIc) is formed mainly of big individuals (34-40cm), which correspond to individuals from 2 years or more.

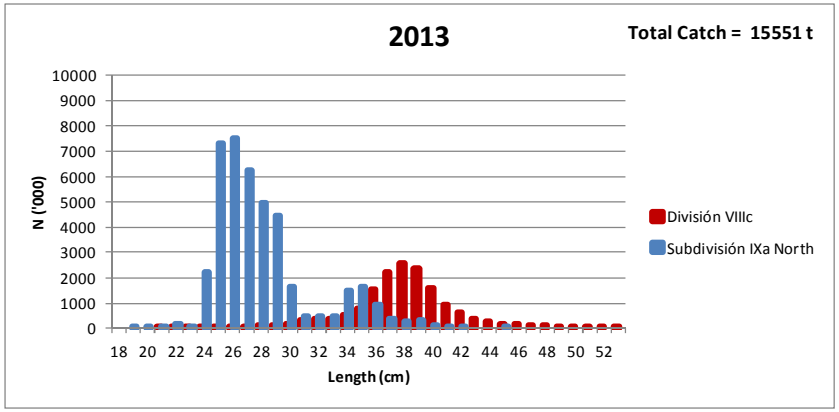
✓ Younger individuals are presented in the commercial catches in Galician waters (ICES div. IXaN). Otoliths from this area will be joined to this study shortly.

✓ A more completed length distribution of chub mackerel in the Bay of Biscay is obtained during the acoustic survey PELACUS, carried out in March-April every year.





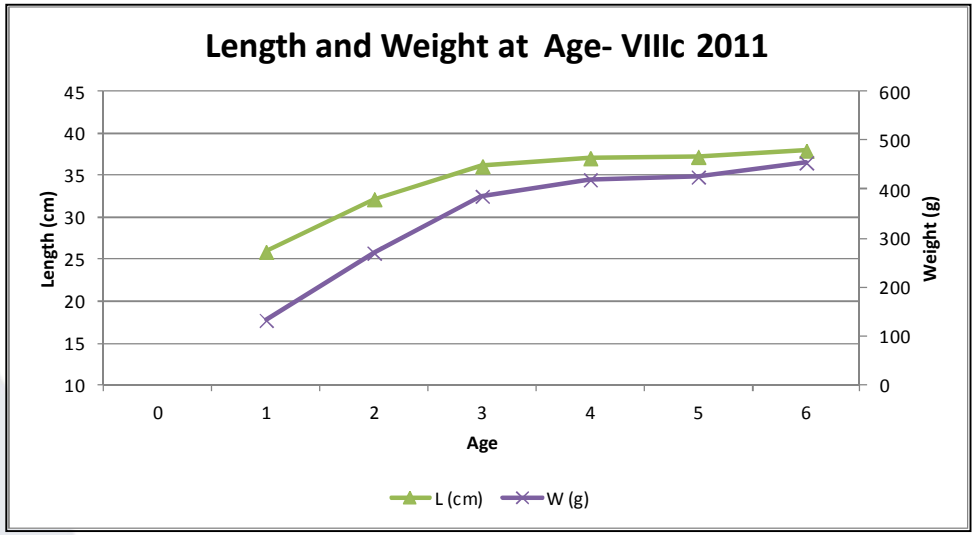


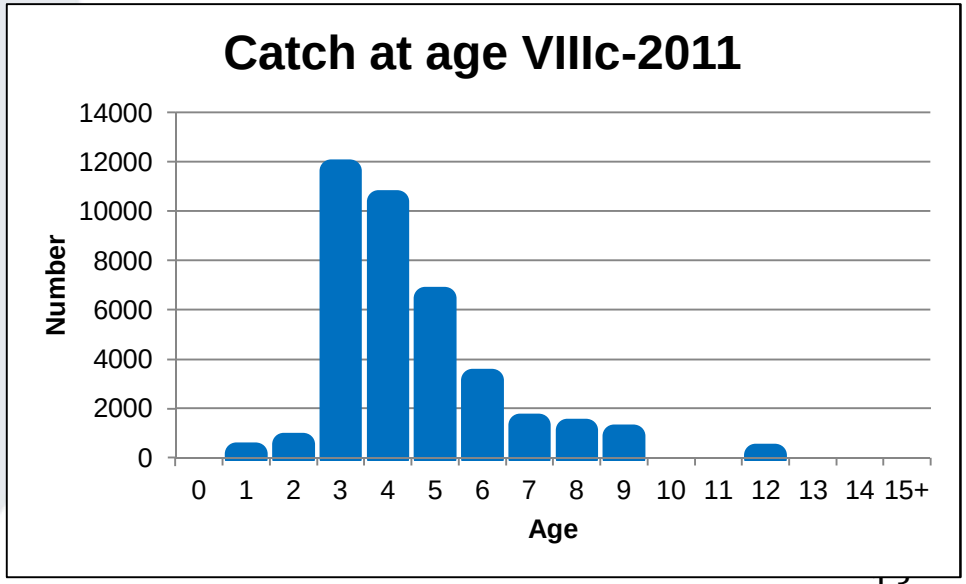


Results

Catch at age 2011

✓ Chub mackerel present in the Bay of Biscay an exponential growth during early years. The growth slow down when the individuals reach 4 years.

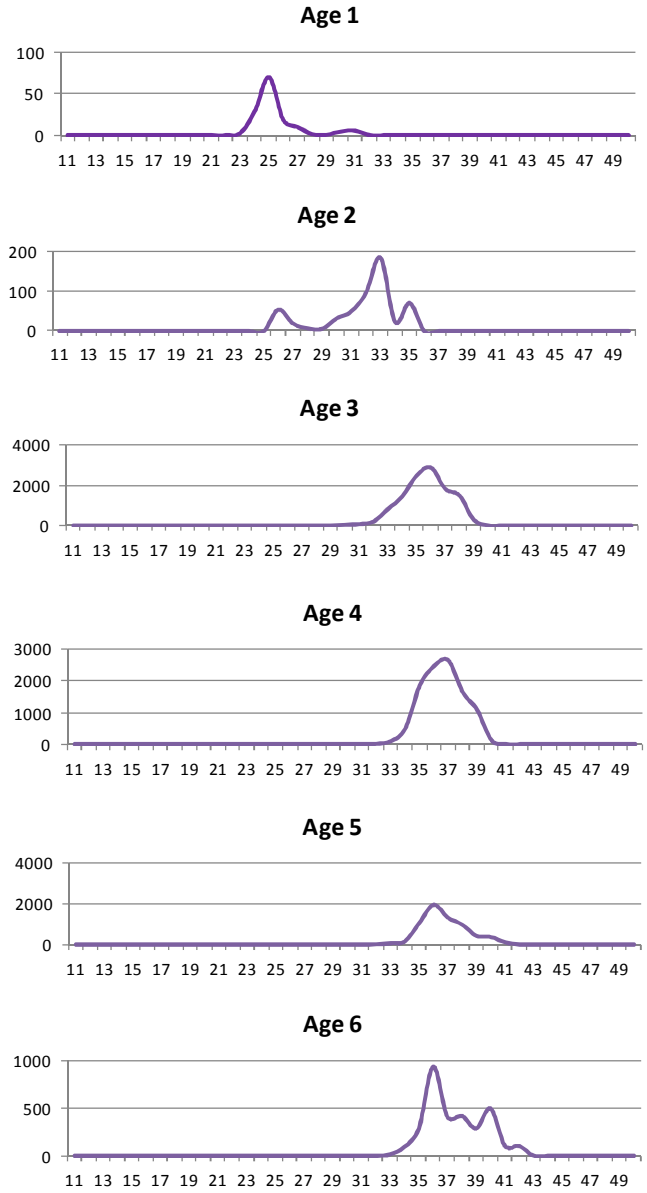




Results

Length frequency distribution by age in the catch 2011

- ✓ Chub mackerel from the catch of 2011 in the Bay of Biscay shows a normal distribution of the length frequency by age.
- ✓ This gives consistency to the age estimation criteria in which this study is based.



Summary and Conclusions

- ✓ The age reading method of chub mackerel otoliths is based on the **knowledge of the date of capture** and the **annual growth pattern** of the Chub mackerel otoliths.
- ✓ **Age** equals the number of **complete opaque growth zones** corresponding to the expected annual growth pattern of the otolith and excluding the marginal edge development of the year (criteria of complete growth zones).
- ✓ A **linear decreasing interval between increments** was observed in this study, this being a **verification criterion** that forms the basis of age estimation
- ✓ Seasonal otolith edge formation: **winter (hyaline) annulus** predominate from **January to Apri**l, with a maximum in April, and the **opaque annulus** predominate from **May to December**. **RMD** is also **higher** in the second half of the year, between **July and December**.
- ✓ Typical chub mackerel otoliths from Bay of Biscay present a **second annulus** with a characteristic **wide** area.
- ✓ Some otoliths present a well marked false ring or **check** around the middle of the second annulus that is usually well identifiable.
- ✓ Others otoliths presents one or more **checks** well marked, which make more difficult the estimation of their age as can be mistaken with true rings. This is more frequent in otoliths from older individuals.
- ✓ The commercial catches of chub mackerel in the Bay of Biscay is formed mainly of big individuals (**34-40cm)**, which correspond to individuals from **2 years or more**.
- ✓ During early years, chub mackerel individuals growth exponentially. When they reach the age 4 the growth slow down.
- ✓ The otolith selection for this study was made in order to obtain a good representation of otoliths by month, sex and length. Future steps in this study will include a more completed selection by age in order to include in the analysis individuals older than age 4. A good representation of otoliths by age also will allow a study of the AMD to observe the differences in the edge formation by age. Also, a next step in this study will be the addition of the analysis of the chub mackerel otoliths from Galician waters (ICES div. IXaN).